*Paper*

# Percutaneous Coronary Intervention in the Elderly

Simon J Walsh, Kathy McAuley, Paul W Johnston

## ABSTRACT

Objective: To determine the clinical risks and procedural outcomes for elderly patients undergoing percutaneous coronary intervention (PCI).

Method: A retrospective case-load analysis was performed of all patients over the age of 80 years, undergoing PCI, over a two-year period, in a tertiary referral hospital. Patient demographics, procedural details and in-hospital complications were obtained by reviewing patient notes. Twelve-month outcomes were obtained from telephone follow-up to the general practitioners and all surviving patients.

Results: There were 55 procedures. Procedural risk was high, with a median TIMI risk score of four (IQR 3-6) and a median additive EuroSCORE of nine (IQR 8-10). There was a 95% angiographic success rate. There were no in-hospital complications. Median Canadian Cardiovascular Society angina class fell from four (IQR 3-4) to one (IQR 0-1). At one year there were twelve deaths (10 cardiovascular), eight of these occurred in patients who had incomplete revascularisation.

Conclusion: PCI can be performed in an elderly, high-risk population with a low in-hospital mortality and marked symptomatic benefit. However, there is a significant 1-year mortality, particularly in patients who are only suitable for partial revascularisation.

## INTRODUCTION

The benefit of coronary revascularisation in the elderly has not been clearly demonstrated. Most randomised trials, showing a benefit from coronary revascularization, have recruited patients under the age of 75.[1] However, it has been clearly demonstrated that procedure-related complications increase with age for both coronary artery bypass grafting (CABG)[2-4] and percutaneous coronary intervention (PCI).[5,6] Furthermore, co-morbid factors have a greater contribution to late outcomes in an elderly population. Consequently a retrospective case-load analysis of patients over the age of 80 years, undergoing PCI in our institution, was performed to assess procedural risks and clinical outcomes.

## METHODS

A hospital database search revealed all patients over the age of 80 years, who had undergone PCI in our institution over a two-year period, from January 2003 to December 2004. All charts were reviewed for demographic and procedural data.

Procedures were classified using the British Cardiovascular Intervention Society categories of stable angina, primary angioplasty and unstable coronary syndromes (including unstable angina, non-ST elevation myocardial infarction and post-ST elevation myocardial infarction). Patient and procedural risk was calculated for each case using the TIMI risk score[7] and the EuroSCORE.[8,9]

Where patients had been discussed with a cardiac surgeon the outcome of that surgical referral was recorded. The coronary anatomy, left ventricular function and the completeness of the revascularisation procedure was documented.

Follow-up was by telephone to all general practitioners to establish the incidence of the major adverse cardiovascular events – death, myocardial infarction, coronary revascularisation and stroke. All surviving patients were also contacted by telephone to confirm the incidence of adverse events and establish angina symptom status. Angina status was recorded using the Canadian Cardiovascular Society classification. Data was available for hospital discharge and complete to 1 year.

## RESULTS

A total of 55 angioplasty procedures were performed in 53 patients. There were 25 males (47%) with a median age of 81 (range 80-91) years, 11 patients (21%) were diabetic (Table I).

The clinical presentation was stable angina in 22 patients (40%), an acute coronary syndrome in 32 patients (58%) and acute myocardial infarction in one patient (2%). The median TIMI risk score was 4 (IQR 3-6) the median additive EuroSCORE was 9 (IQR 8-10), and the median logistic EuroSCORE (which is more predictive of surgical mortality

Regional Medical Cardiology Centre, 1st Floor West Wing, Royal Victoria Hospital

Grosvenor Road, Belfast. BT12 6BA

Correspondence to: Dr Johnston

Email: paul.johnston@royalhospitals.n-i.nhs.uk

*Table I.* Patient demographics including - risk factors, past medical history, clinical presentation, renal function, angiographic findings and calculated risk scores.

| Characteristic | No. of patients |
|---|---|
| Age (years) | 81 (81-82) |
| Male | 25 (47) |
| Diabetic | 11 (21) |
| History | |
|     Prior PCI | 10 (19) |
|     Prior CABG | 8 (15) |
| Clinical Presentation | |
|     Stable Angina | 22 (40) |
|     Acute Coronary Syndrome | 32 (58) |
|     Primary Angioplasty | 1 (2) |
| Glomerular Filtration Rate (ml/min) | 41 (31-53) |
| LVEF | |
|     >50% | 30 (55) |
|     40-49% | 13 (24) |
|     30-39% | 9 (16) |
|     <30% | 3 (5) |
| Angiographic findings of diseased vessels | |
|     1 | 15 (27) |
|     2 | 15 (27) |
|     >=3 | 25 (45) |
|     LMS | 3 (5) |
| TIMI Risk Score | 4 (3-6) |
| EuroSCORE | |
|     Additive | 9 (8-10) |
|     Logistic | 12 (8-21) |

Data are expressed as number (%) or median (inter-quartile range)

PCI; Percutaneous Coronary Intervention. CABG; Coronary Artery Bypass Graft.

LVEF; Left Ventricular Ejection Fraction. LMS; Left Main Stem.

TIMI; Thrombolysis in Myocardial Infarction.

in high-risk patients)[9] was 12 (IQR 8-21). Renal function, calculated by the Cockroft-Gault formula,[10] was significantly impaired with a median glomerular filtration rate (GFR) of 41mls/min (IQR 31-53 ). Only 7 of the 53 patients had a GFR ≥60mls/min.

Twenty-five patients (45%) had triple vessel disease and 15 patients (27%) each had single or double vessel disease. Eleven patients (21%) had moderate or severely impaired left ventricular function. Eleven patients (21%) were referred for CABG and seven were deemed unsuitable for surgical revascularisation. Four patients were accepted for surgery but underwent PCI because of patient preference (two patients) or because of clinical instability (two patients). During the same two-year period only 19 patients over the age of 80 underwent isolated CABG in our institution.

*Table II.* Procedural characteristics including vessels treated, equipment used and angiographic success.

| Characteristic | No (%) |
|---|---|
| No of Vessels Treated | |
|     1 | 42 (76) |
|     2 | 13 (24) |
|     Incomplete revascularisation | 35 (64) |
| Vessel Treated | |
|     LAD | 23 (34) |
|     LCx | 22 (33) |
|     Intermediate | 2 (3) |
|     RCA | 13 (19) |
|     SVG | 4 (6) |
|     IMA | 1 (2) |
|     Bifurcation branch | 2 (3) |
| Stents | |
|     Median Number per case | 2 (1-3) |
|     Stent Diameter (mm) | 3.0 (2.75-3.5) |
|     Stent Length (mm) | 25 (18-36) |
|     Drug Eluting stent | 39 (41) |
| 2b3a Inhibitor use | 26 (47) |
| Intra-aortic balloon pump | 1 (2) |
| Angiographic Success | 52 (95) |

Data are expressed as number (%) or median (inter-quartile range)

LAD; Left Anterior Descending. LCx; Left Circumflex.

RCA; Right Coronary Artery. SVG; Saphenous Vein Graft.

IMA; Internal Mammary Artery.

The majority of patients had single vessel PCI (42, 76%), but 13 patients had multi-vessel PCI (24%). In the 55 procedures 96 coronary stents were deployed (41% were drug-eluting) and the median total stent length per patient was 25 (IQR 18-36)mm. The angiographic success rate in treated vessels was 95%. Thirty-five patients (64%) underwent ischaemia-driven target vessel (i.e. incomplete) revascularisation; the remainder had complete revascularisation (Table II).

No acute complications occurred as a result of the procedures and all patients survived to hospital discharge (Table III). Total follow-up was 943 patient months. There were 12 deaths (10 cardiovascular) in the first year, giving a 78% 1-year survival. Of the 10 deaths 8 had presented with an acute coronary syndrome and 8 had undergone partial revascularisation. No patient experienced a stroke but there was one non-fatal MI and there were three target vessel revascularisations. The median Canadian Cardiovascular Society angina class fell from 4 (IQR 3-4) pre-procedure to 1 (IQR 0-1) in surviving patients (p=0.003).

## DISCUSSION

The early randomised trials demonstrating a clinical benefit

*Table III.* In hospital and 12 month outcomes

| Complication | No (%) |
|---|---|
| **In Hospital** | |
| Death | 0 |
| Q Wave Myocardial Infarction | 0 |
| Urgent Target Vessel Revascularisation | 0 |
| CVA | 0 |
| | |
| **12 Month** | |
| Death | 12 (22) |
| Non-fatal Myocardial Infarction | 1 (2) |
| Target vessel revascularisation | 3 (5) |
| CVA | 0 |

CVA; Cerebrovascular Accident.

from coronary revascularisation specifically excluded elderly patients.[1] However, it has been well documented that elderly patients undergoing CABG have increased peri-operative morbidity and mortality rates.[2-4] Similarly, elderly patients undergoing PCI have increased procedural complications and death.[5,6] There have been two recent publications looking specifically at clinical outcomes in the elderly population undergoing coronary revascularisation. In the Alberta Provincial Project for Outcomes Assessment in Coronary Heart Disease (APPROACH) database, the outcomes of 983 patients over the age of 80 years, who had undergone coronary angiography were reviewed.[11] Of these 983 patients, 289 underwent PCI, 133 received CABG and 561 were treated medically. They were compared with patients aged 70-79 and those aged less than 70. The database demonstrated that, for all age groups, there was a relative risk reduction in mortality for revascularisation compared with medical therapy. Furthermore, this benefit was greatest in the over 80s. However, the authors recognised that this was a non-randomised trial and open to the obvious bias that surgeons and interventional cardiologists are more likely to operate on a healthy elderly patient than one with multiple co-morbidities. In the Trial of Invasive versus Medical therapy in the Elderly (TIME) trial, 282 patients aged >75 years were randomised to maximal medical therapy or coronary angiography and revascularisation where feasible.[12] After 1 year there was no difference with regard to symptoms, quality of life, and the risk of death or non-fatal myocardial infarction between the two groups. However, by the end of the year some 46% of the medical management patients had undergone coronary revascularisation.

Our study involved a very high-risk population. The median age was 81 years, 60% had an acute myocardial infarction or acute coronary syndrome, 50% had left main stem of three-vessel coronary disease and 21% had moderate or severely impaired left ventricular function. The TIMI risk score is a strong independent predictor of outcomes in patients with unstable coronary syndromes.[7] The median TIMI risk score in our population was 4. In one large study, a TIMI risk score of 4 predicted a 20% risk of death, myocardial infarction or urgent coronary revascularisation within 14

days of presentation.[7] The EuroSCORE is used by surgeons to predict mortality for patients undergoing cardiac surgery.[8] The logistic EuroSCORE is a better reflection of predicted mortality in a high risk population.[9] In this study population the median additive EuroSCORE was 9 and the median logistic EuroSCORE was 12. For comparison, the median additive EuroSCORE for a sample of patients accepted for cardiac surgery in 2002 in a neighbouring hospital was 3 and for those turned down by the cardiac surgeons was 5.[13] Eleven of our patients were discussed with the cardiac surgeons and seven were declined surgery on the basis of operative risk. In this study the median GFR of 41ml/min was also a strong indicator of increased clinical risk. In a recent study of patients undergoing CABG, a GFR <60ml/min was shown to be a strong independent risk factor for 30 day mortality.[14] In addition to these markers of a high risk population, the complexity of our procedures is reflected in the interventional equipment required. In particular the median stent length per patient was 25 (IQR 18-36) mm, indicating very extensive disease.

Despite this very high-risk population, there were no in-hospital deaths or clinically significant complications. This contrasts with a large US database of octogenarians undergoing PCI, where the rates of in-hospital mortality, Q wave myocardial infarction and CVA were 3.8%, 1.9% and 0.6% respectively.[6] In our study population there was also a substantial improvement in symptom status, with the median Canadian Cardiovascular Society angina class falling from 4 (IQR 3-4) to 1 (IQR 0-1). However, in our study there was a significant 1-year major adverse cardiac event rate. There were 12 deaths and 10 of these were cardiovascular. Of the 10 deaths 8 had undergone partial revascularisation. The 1 year mortality rate of 23% and combined death or non-fatal myocardial infarction rate of 25% were both greater than those seen in the TIME study where rates were 11% and 17% respectively.[12] However, patients in the TIME study had stable ischaemic heart disease, only being randomised to invasive or conservative strategies if they had survived 6 months after enrolment.

## CONCLUSIONS

Percutaneous coronary intervention can be performed in an elderly high-risk population. It is associated with a high angiographic success rate, a low in-hospital mortality and substantial symptomatic benefit. However, there is a significant 1-year mortality, particularly in patients who are only suitable for partial revascularisation, and they should have aggressive secondary preventative therapy.

**The authors have no conflict of interest**

## REFERENCES

1.  Lee PY, Alexander KP, Hammill BG *et al.* Representation of elderly persons and women in published randomized trials of acute coronary syndromes. *JAMA* 2001; **286(6)**:708–13.

2.  Alexander KP, Anstrom KJ, Muhlbaier LH, Gresswald RD, Smith PK, Jones RH, et al. Outcomes of cardiac surgery in patients age 80 years: results from the National Cardiovascular Network. *J Am Coll Cardiol.*

2000; **35(3)**:731–8.

3.  Engoren M, Arslanian-Engoren C, Steckel D, Neihardt J, Fenn-Buderer N. Cost, outcome, and functional status in octogenarians and septuagenarians after cardiac surgery. *Chest* 2002;**122(4)**:1309-15.

4.  Barnett SD, Halpin LS, Speir AM, Albus RA, Aki BF, Massimiano PS, *et al.* Postoperative complications among octogenarians after cardiovascular surgery. *Ann Thorac Surg* 2003;**76(3)**:726-31.

5.  De Gregorio J, Kobayashi Y, Albiero R, Reimers B, Di Marco C, Finci L, *et al.* Coronary artery stenting in the elderly: short-term outcome and long-term angiographic and clinical follow-up. *J Am Coll Cardiol*. 1998;**32(3)**: 577–83.

6.  Batchelor WB, Anstrom KJ, Muhlbaier LH, Grosswald R, Weintraub WS, O'Neill WW, *et al.* Contemporary outcome trends in the elderly undergoing percutaneous coronary interventions: results in 7472 octogenarians. National Cardiovascular Network Collaboration. *J Am Coll Cardiol* 2000;**36(3)**:723–30.

7.  Antman EM, Cohen M, Bernink PJ, McCabe CH, Horacek T, Papuchis G, *et al.* The TIMI risk score for unstable angina/non-ST elevation MI: A method for prognostication and therapeutic decision making. *JAMA* 2000;**284(7)**:835–42.

8.  Roques F, Nashef SAM, Michel P, Gauducheau E, de Vincentiis C, Baudet E, *et al.* Risk factors and outcome in European cardiac surgery: analysis of the EuroSCORE multinational database of 19030 patients. *Eur J Cardiothorac Surg* 1999;**15(6)**:816–23.

9.  Michel P, Roques F, Nashef SAM. EuroSCORE Project Group. Logistic or additive EuroSCORE for high-risk patients? *Eur J Cardiothorac Surg* 2003;**23(5)**:684-7.

10. Cockcroft DW, Gault MH. Prediction of creatinine clearance from serum creatinine. *Nephron* 1976;**16(1)**:31–41.

11. Graham MM, Ghali WA, Faris PD, Galbraith PD, Norris CM, Knudtson ML, *et al* Survival after coronary revascularisation in the elderly. *Circulation* 2002;**105(20)**:2378-84.

12. Pfisterer M, Buser P, Osswald S, Allemann U, Amann W, Angehrn W, *et al.* Outcome of elderly patients with chronic symptomatic coronary artery disease with an invasive vs. optimized medical treatment strategy: one-year results of the randomized TIME trial. *JAMA* 2003;**289**:1117–23.

13. Horan PG, Leonard N, Herity NA. Progressively increasing operative risk among patients referred for coronary artery bypass surgery. *Ulster Med J* 2006;**72(2)**:136-40.

14. Hillis GS, Croal BL, Buchan KG, El-Shafei H, Gibson G, Jeffrey RR, *et al.* Renal function and outcome from coronary artery bypass grafting: impact on mortality after a 2.3-year follow-up. *Circulation* 2006;**113(8)**:1056-62.

# Correction:

**We apologise for the printer's error in some editions of the September edition of journal in the Interview by Claire Lundy on page 231. The final word 'skills' was omitted and the final sentence should have read:**

'I would recommend being a portfolio GP: it allows choice and variety in your working life and delivers opportunities to develop new skills'.

**This was corrected on the website version in early September and the corrected article can be accessed free of charge at www.ums.ac.uk**